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R. H. Bennett 1817
Sept. Eleven

T A B L E S

OF THE

APPARENT PLACES

OF THE COMET OF 1661.

T A B L E S

OF THE

A P P A R E N T P L A C E S

OF THE C O M E T OF 1661,

WHOSE RETURN IS EXPECTED IN 1789.

To which is added,

A new Method of using the RETICULE RHOMBOÏDE.

B Y

SIR HENRY ENGLEFIELD, BART.
F.R.S. and F.A.S.

L O N D O N :

PRINTED FOR P. ELMSLY, IN THE STRAND.

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P R E F A C E.

THE following Tables, with the few pages of explanation annexed, were in great measure computed, and the large plate of the comet's orbit was engraved, before I had heard that Monf. Pingrè had computed Tables of the same sort, which were to be published in the *Connoissance des Temps* for 1789. These would certainly have hindered my undertaking the present work; but as it was so far advanced, and as my Tables are much more copious than those of Mr. Pingrè, and the elements I have used somewhat different, I thought it might not be deemed useless to publish this work.

In a business of this sort, where a small change in the elements of the comet, or its arrival at the perihelion in the intervals of the supposed tabular times, must make a considerable change in the apparent places, much accuracy in computing them would have been an useless waste of labour: they therefore were found by construction only, in the way given at large in the subsequent pages.

Those who wish for a particular account and history of the Comet in question, will find it in Mr. Pingrè's Treatise above referred to, or in the Comêtographie of that excellent author: There is also a most ingenious Memoire on this subject published by Monf. Mechain, in the Histoire de L'Academie des Sciences.

To the Tables of the Comet I have subjoined a method of observing with the Reticule Rhomboide, which I have long practised with much success, and indeed have reason to think as accurate as the usual method of using it. This may be of peculiar use to persons who may see the comet in the southern hemisphere, in the course of a voyage, and who, with a telescope and tolerable watch, may at once make most valuable observations, if they are but for a day or two at land.

TABLES

T A B L E S

OF THE

A P P A R E N T P L A C E S

OF THE

C O M E T O F 1661.

WHEN Dr. Halley, in consequence of the discoveries of his illustrious friend and master, Sir Isaac Newton, applied himself to calculate the parabolic orbits of all the comets, of which sufficient observations had been made; he found such a similarity in the elements of several of them, as to render it almost certain that they were returns of the same comets, moving in extremely extended ellipses, and visible only in the inferior part of their orbits. The first of these, whose period is about 75 years, and which had been observed in 1456, 1531, 1607, and 1682, he announced for the year 1759, as the perturbations of the planets, he thought,

thought, might lengthen its period, and retard its return to the sun about a year.

What Halley had predicted on a general view of the system; the celebrated Monf. Clairault, with equal genius and labour, reduced to an accurate calculation; and gave the last decisive proof of the truth of the Newtonian system of universal attraction, by ascertaining the period of the comet's revolution within a month; though the perturbations had amounted to no less than 588 days.

An equal similitude in the elements of the comets of 1532 and 1661, induced Dr. Halley to predict its return for the year 1789; but as the time of its arrival at the perihelion must be, from the perturbations of the planets, uncertain within a few months, and its first appearance will be in the southern part of the heavens; I have thought that it might not be useless to construct Ephemerides for its apparent place to every eight days, supposing its arrival at the perihelion to be every sixteen days for a year; in order to guide persons resident in the southern hemisphere, or near the equator, in their search for it. And as all the places were laid down from the large drawing of the orbit, which accompanies this book, and its places for any other given time on any supposition of its arrival at the perihelion, may be with great ease found by the same method; it will be proper to give a short account both of the drawing and method of computation from it.

The

The outer double lined circle represents the ecliptic, having the sun in its centre, and is divided into signs and degrees.

The orbit of the earth is represented by an eccentric circle, whose radius is six inches, which is taken as the mean distance of the earth from the sun; and it is divided to every fourth day from July 1788 to July 1789.

The orbit of the comet is represented by the parabola, divided and numbered to every fourth day, in its true dimensions; the ends of the lines which are perpendicular to the line of nodes, with the same numbers by them, are the places of the comet projected on the plane of the ecliptic.

These points are thus found: Let fall a perpendicular from the place of the comet in its orbit, on the line of nodes, and find its value in parts of the sun's mean distance from the earth, taken as unity; then with that perpendicular for radius, find the cosine of the inclination of the comet's orbit in parts of the sun's mean distance from the earth, and set that off on the perpendicular before mentioned, from the line of nodes towards the comet's place.

The numbers given in Table I. are the perpendicular distances of the comet from the plane of the ecliptic, in parts of the sun's mean distance from the earth, which is taken as unity.

These distances are also set off on the corresponding lines of projected place, from the line of nodes towards the comet's place; as having them given saves much time in finding the comet's place by construction.

These distances are found by making the cosine of the inclination found as above, radius, and taking the tangent of the inclination = to the distance from the plane of the ecliptic in parts of the sun's mean distance from the earth.

With these data the comet's geocentric place is quickly found, in the following manner:

For the longitude, draw a line from the place of the earth to the projected place of the comet, and a parallel line passing through the sun, will cut the ecliptic in the comet's geocentric longitude sought.

For the latitude: With the distance of the earth from the projected place of the comet for radius, make the perpendicular distance of the comet from the plane of the ecliptic, found in Table I. Tangent; the angle given will be the geocentric latitude sought.

Should any one be desirous of knowing the real geocentric distance of the comet, it is readily found by the drawing and Table I. it being ever the hypotenuse of a right angled triangle, one of whose sides is the distance of the earth from the comet's projected place; the other is the per-

perpendicular distance of the comet from the plane of the ecliptic.

All these operations are readily performed with a good sector, and to a much greater degree of accuracy than is requisite for operations of this nature.

The projected points and table of perpendicular distances were found by this means, which otherwise would have consumed much time in computing.

The elements of the comet's orbit, which I have used for the drawing, and apparent places given in the ensuing Tables, are those given by Dr. Maskelyne in his Announce of the Comet, and are as follow :

Perihelion distance	- - - -	0.44851
Place of ascending node	- - - -	2°. 24'. 18"
Inclination of the orbit to the ecliptic	-	32.36
Perihelion forwarder in the orbit than the ascending node	- - - -	33.28
Motion direct.		

The Tables give the apparent longitudes and latitudes of the comet on fifteen different suppositions of its arrival at the perihelion, viz. from August 25, 1788, every sixteen days, to August 12, 1789. These places will, without much error, serve for the same days in the following years, should the return of the comet be so long delayed.

In each supposition, its place is given every eighth day, from 96 days before the perihelion, to the same time after it, unless the comet's projected distance from the earth exceeds double the distance of the earth from the sun; in which case it can be scarcely visible, even to the best telescope, particularly in its descent to the sun.

The inspection of the drawing will shew, that its appearance will be very inconspicuous to us, if its return should happen during the summer months. Indeed in the northern hemisphere, we have in that case scarce a chance of seeing it at all. Those persons, therefore, who inhabit the southern climates, should redouble their search, lest it should pass entirely unobserved.

During the winter and spring months, it will probably force itself on our notice, unless its state be much altered since its last appearance, a thing by no means improbable, as it seems that, in the very same circumstances, the colour and size of the same comet varies much.

As the orbit of this comet is much inclined to the ecliptic, and the line of nodes is not near the point of intersection of its orbit with that of the earth, it can never approach very near us. The smallest distance possible is when it passes the earth's orbit after the perihelion, which happens at forty-four days after, when its distance from the plane of the ecliptic is .4250, or about $\frac{4}{10}$ ths of the distance from the
2
sun

sun to the earth. Should the earth then be in that point of its orbit, the comet will pass through the north pole of the ecliptic with a rapid apparent motion.

Its distance from the earth's orbit, when it passes it in descending to the sun, is much greater, being .5960, or $\frac{6}{10}$ ths of the sun's distance. This happens forty-seven days before the perihelion.

The places of the comet are given for every eighth day throughout each period, though in many instances it will not be visible from its proximity to the sun, particularly in summer, when it will be almost in superior conjunction for a month on each side the perihelion.

Should the earth be in the line of nodes, and on the same side when the comet passes its ascending node, it may visibly transit the sun's disk. This, however curious, is a sight we have not much reason to expect, as so nice a coincidence of circumstances is very improbable.

The descending node cuts the comet's orbit far beyond the earth.

From the position of the ascending node, the comet cannot make any very near approach to Venus; and the orbit of Mercury is included in that of the comet, and considerably nearer the sun than the perihelion distance of the comet.

These

These are the principal circumstances relative to the next return of the expected comet, which, however, is still a doubtful event. Nor should its non-appearance lead any one to think, that the foundations of astronomy are erroneous or doubtful. When we consider the very small probable quantity of matter contained in comets, when compared with planets, the larger ones particularly, and the slowness of their motion when in the neighbourhood of Jupiter and Saturn, which exposes them the longer to the action of their attractive power: above all, when the discovery of the Georgium Sidus, a body of considerable magnitude, and placed at double the distance from the sun of the furthest planet known before, points out another disturbing cause, more potent, as further removed from the great center of attraction; and may even lead us to a belief, that the limits of the planetary system may not even be placed at that vast distance, but the attraction of the sun may guide other regularly revolving bodies, perhaps forever invisible to our most powerful telescopes: we may perhaps wonder rather, that any comet preserves the figure of its orbit, so as to prove its identity in its different returns to the sun, than that such a phenomenon happens so seldom.

The real size of different comets certainly varies most astonishingly; and the attention of the present race of astronomers has discovered many, which even in the last century would have passed unobserved, and before the invention of tele-

telescopes could not have been seen; so that perhaps as yet we have not had the return of those vast comets which forced themselves into the notice of our ancestors. Yet still it is rather singular, that among twenty-six calculated by Halley, three should have borne very strong marks of identity, and that the fifty comets observed since his time should not have added one to that number.

I cannot help therefore suspecting, that, besides those comets whose orbits may have been so far altered, as totally to quit the sun, and wander through the immeasurable voids of space, till they fall within the sphere of attraction of some other star (an hypothesis by no means improbable), many may have returned so much altered in the figure and position of their orbits, as to be totally unknown to us for the same. Indeed of this we have one most striking instance in the comet of 1770, whose period, as deduced from its appearance at that time, was only five years and an half, as separately computed by Messrs. Lexell and Pingrè; and yet this comet has appeared no more, at least so as to be recognizable by us.

This then has proved beyond a doubt the vast changes incident to these singular bodies; and as the proof of their returning rests as yet on a single instance, we are so far at least authorised to say, that possibly as many may be altered as not.

T A B L E I.

Perpendicular Distances of the COMET from the Plane of the Ecliptic.

South of the Ecliptic.

North of the Ecliptic.

Days before the Perihelion	Distance.	Days before the Perihelion	Distance.	Days before the Perihelion	Distance.	Days after the Perihelion	Distance.
100	1 . 0850	40	0 . 5000	4	0 . 0650	44	0 . 4250
96	1 . 0610	36	0 . 4500	Perihel.	0 . 1370	48	0 . 4290
92	1 . 0300	32	0 . 4000	Days after the Perihelion		52	0 . 4310
88	0 . 9900	28	0 . 3400			56	0 . 4400
84	0 . 9550	24	0 . 2800			60	0 . 4410
80	0 . 9200	20	0 . 2150	4	0 . 1920	64	0 . 4420
76	0 . 8800	16	0 . 1500	8	0 . 2470	68	0 . 4420
72	0 . 8420	12	0 . 0850	12	0 . 2900	72	0 . 4420
68	0 . 8050	8	0 . 090	16	0 . 3250	76	0 . 4410
64	0 . 7620			20	0 . 3530	80	0 . 4400
60	0 . 7210			24	0 . 3740	84	0 . 4340
56	0 . 6840			28	0 . 3920	88	0 . 4300
52	0 . 6450			32	0 . 4050	92	0 . 4290
48	0 . 5960			36	0 . 4175	96	0 . 4270
44	0 . 5500			40	0 . 4225	100	0 . 4250

Perihelion, Aug. 25, 1788.

Perihelion, Sept. 10, 1788.

Days of the Month.	Distance from Perihelion in days.	Geocentric Longitude. S ° '	Geocentric Latitude. ° '	Days of the Month.	Distance from Perihelion in days.	Geocentric Longitude. S ° '	Geocentric Latitude. ° '
June 14	72	1 . 7 . 15	25 . 0 S	June 22	80	1 . 5 . 50	28 . 0 S
22	64	1 . 15 . 0	24 . 45	30	72	1 . 12 . 45	27 . 55
30	56	1 . 23 . 15	24 . 0	July 8	64	1 . 21 . 0	27 . 45
July 8	48	2 . 2 . 30	22 . 40	16	56	2 . 0 . 0	27 . 20
16	40	2 . 13 . 15	20 . 30	24	48	2 . 10 . 15	25 . 50
24	32	2 . 24 . 40	17 . 15	Aug. 1	40	2 . 21 . 45	23 . 30
Aug. 1	24	3 . 7 . 45	12 . 15	9	32	3 . 4 . 30	19 . 45
9	16	3 . 21 . 40	6 . 40	17	24	3 . 18 . 10	13 . 50
17	8	4 . 6 . 10	0 . 10	25	16	4 . 2 . 45	7 . 30
25	Perihel.	4 . 22 . 0	5 . 45 N	Sept. 2	8	4 . 17 . 30	0 . 15
Sept. 2	8	5 . 7 . 30	9 . 45	10	Perihel.	5 . 3 . 40	6 . 15 N
10	16	5 . 22 . 30	12 . 0	18	8	5 . 18 . 20	10 . 0
18	24	6 . 5 . 20	13 . 0	26	16	6 . 2 . 45	12 . 15
26	32	6 . 16 . 30	13 . 10	Oct. 4	24	6 . 15 . 0	12 . 50
				2	32	6 . 25 . 20	13 . 0

Perihelion, Sept. 26, 1788.

Perihelion, Oct. 12, 1788.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° '	Geocentric Latitude. ° '	Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° '	Geocentric Latitude. ° '
June 22	96	0 . 28 . 0	30 . 15 S	July 8	96	1 . 1 . 15	34 . 0 S
30	88	1 . 4 . 0	31 . 0	16	88	1 . 7 . 0	35 . 20
July 8	80	1 . 10 . 20	31 . 40	24	80	1 . 13 . 30	36 . 30
16	72	1 . 17 . 45	32 . 0	Aug. 1	72	1 . 21 . 30	37 . 50
24	64	1 . 26 . 30	32 . 30	9	64	2 . 1 . 20	38 . 50
Aug. 1	56	2 . 6 . 30	32 . 10	17	56	2 . 12 . 15	39 . 30
9	48	2 . 18 . 0	31 . 15	25	48	2 . 25 . 30	38 . 30
17	40	3 . 1 . 0	28 . 30	Sept. 2	40	3 . 11 . 0	35 . 40
25	32	3 . 15 . 0	24 . 0	10	32	3 . 26 . 50	30 . 0
Sept. 2	24	4 . 0 . 0	16 . 45	18	24	4 . 13 . 30	20 . 30
10	16	4 . 15 . 0	8 . 30	26	16	4 . 29 . 0	10 . 15
18	8	5 . 0 . 0	0 . 25	Oct. 4	8	5 . 13 . 0	0 . 30
26	Perihel.	5 . 15 . 0	6 . 40 N	12	Perihel.	5 . 27 . 30	7 . 15 N
Oct. 4	8	5 . 29 . 40	10 . 30	20	8	6 . 11 . 30	11 . 0
12	16	6 . 13 . 0	12 . 30	28	16	6 . 24 . 0	12 . 50
20	24	6 . 24 . 35	13 . 0	Nov. 5	24	7 . 4 . 30	13 . 15
28	32	7 . 4 . 15	13 . 0	13	32	7 . 13 . 20	13 . 15

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Perihelion, Oct. 28, 1738.

Perihelion, Nov. 13, 1788.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.		Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.	
		S	O	'					S	O	'		
July 24	96	1	2	25	39	15 S	Aug. 9	96	1	0	20	45	30 S
Aug. 1	88	1	7	40	41	25	17	88	1	4	20	48	45
9	80	1	14	0	43	30	25	80	1	9	40	52	20
17	72	1	22	15	45	40	Sept. 2	72	1	16	20	56	40
25	64	2	2	40	48	10	10	64	1	26	20	61	45
Sept. 2	56	2	15	40	50	15	18	56	2	11	30	66	15
10	48	3	2	30	50	45	26	48	3	8	45	69	45
18	40	3	23	0	47	30	Oct. 4	40	4	14	25	66	40
26	32	4	12	50	40	0	12	32	5	11	25	55	0
Oct. 4	24	5	1	0	26	30	20	24	5	28	10	35	30
12	16	5	15	50	12	40	28	16	6	8	40	16	0
20	8	5	28	30	0	45	Nov. 5	8	6	17	20	1	0
28	Perihel.	6	11	25	8	0 N	13	Perihel.	6	27	0	9	5 N
Nov. 5	8	6	23	35	12	0	21	8	7	7	0	13	0
13	16	7	4	45	13	45	29	16	7	16	0	14	30
21	24	7	14	15	13	50	Dec. 7	24	7	24	10	14	40
29	32	7	22	0	13	45	15	32	8	1	0	14	30
Dec. 7	40	7	28	25	13	10	23	40	8	7	0	13	50
							31	48	8	12	0	13	5

Perihelion, Nov. 29, 1788.

Perihelion, Dec. 15, 1788.

Days of the Month.	Distance from the Perihel. in days	Geocentric Longitude.			Geocentric Latitude.		
		S	O	'	O	'	
Aug. 25	96	0	21	40	52	50	S
Sept. 2	88	0	22	0	57	0	
10	80	0	22	30	61	30	
18	72	0	22	0	66	50	
26	64	0	18	40	73	0	
Oct. 4	56	0	7	0	79	30	
12	48	10	4	0	86	40	
20	40	8	0	35	77	45	
28	32	7	19	45	63	15	
Nov. 5	24	7	12	45	42	45	
13	16	7	11	10	19	45	
21	8	7	11	15	1	0	
29	Perihel.	7	14	20	10	30	N
Dec. 7	8	7	20	50	14	45	
15	16	7	28	0	16	0	
23	24	8	4	45	16	0	
31	32	8	10	20	15	40	
Jan. 8	40	8	15	20	15	10	
16	48	8	19	30	14	30	
24	56	8	23	0	14	0	
Feb. 1	64	8	25	45	13	30	

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.		
		S	O	'	O	'	
Sept. 10	96	0	3	15	58	0	S
18	88	11	27	35	60	45	
26	80	11	20	0	63	20	
Oct. 4	72	11	9	10	65	15	
12	64	10	26	0	65	50	
20	56	10	12	30	64	30	
28	48	9	29	30	61	0	
Nov. 5	40	9	19	0	56	0	
13	32	9	11	0	48	30	
21	24	9	0	0	36	30	
29	16	8	19	10	19	45	
Dec. 7	8	8	10	10	1	15	
15	Perihel.	8	6	0	12	10	N
23	8	8	7	15	16	45	
31	16	8	11	15	18	0	
Jan. 8	24	8	16	0	17	50	
16	32	8	20	0	17	20	
24	40	8	23	45	16	45	
Feb. 1	48	8	27	20	16	0	
9	56	8	29	30	15	40	
17	64	9	1	40	15	20	
25	72	9	3	0	15	0	
March 5	80	9	4	15	14	45	
13	88	9	5	0	14	20	
21	96	9	4	45	14	15	

Perihelion, Dec. 31, 1788.

Perihelion, Jan. 16, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.		Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.	
		S	°	'					S	°	'		
Sept. 26	96	11	10	20	56	50 S	Oct. 12	96	10	25	30	50	40 S
Oct. 4	88	11	3	0	57	0	20	88	10	20	50	48	40
12	80	10	26	30	56	10	28	80	10	18	0	46	30
20	72	10	19	25	54	15	Nov. 5	72	10	15	30	43	45
28	64	10	13	45	51	45	13	64	10	14	20	41	5
Nov. 5	56	10	10	20	48	30	21	56	10	14	0	38	0
13	48	10	6	40	44	30	29	48	10	14	0	34	45
21	40	10	4	0	40	30	Dec. 7	40	10	15	15	31	40
29	32	10	2	10	35	20	15	32	10	16	30	26	45
Dec. 7	24	9	28	40	27	40	23	24	10	17	0	20	45
15	16	9	23	0	16	45	31	16	10	16	0	12	45
23	8	9	13	20	1	0	Jan. 8	8	10	11	10	0	50
31	Perihel.	9	1	45	13	40 N	16	Perihel.	10	0	0	14	0 N
Jan. 8	8	8	26	45	19	30	24	8	9	19	40	22	0
16	16	8	25	50	20	45	Feb. 1	16	9	13	20	24	25
24	24	8	27	30	20	30	9	24	9	11	30	24	30
Feb. 1	32	9	0	0	19	50	17	32	9	11	20	23	45
9	40	9	2	0	19	15	25	40	9	11	25	23	15
17	48	9	4	20	18	30	March 5	48	9	11	35	22	30
25	56	9	5	45	18	15	13	56	9	11	0	22	15
March 5	64	9	6	25	18	0	21	64	9	9	40	21	45
13	72	9	6	40	17	40	29	72	9	8	0	21	30
21	80	9	6	30	17	30	April 6	80	9	6	0	21	5
29	88	9	5	40	16	50	14	88	9	3	20	20	15
April 6	96	9	4	0	16	45	22	96	8	29	40	20	0

Perihelion, Feb. 1, 1789.

Perihelion, Feb. 17, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.		Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.	
		S	°	'					S	°	'		
Oct. 28	96	10	18	50	43	8 S	Nov. 13	96	10	18	10	37	15 S
Nov. 5	88	10	17	30	41	0	21	88	10	18	35	35	0
13	80	10	17	20	38	35	29	80	10	20	0	33	10
21	72	10	17	25	36	0	Dec. 7	72	10	21	20	30	50
29	64	10	18	15	33	55	15	64	10	23	30	28	45
Dec. 7	56	10	20	0	31	20	23	56	10	26	40	26	40
15	48	10	22	0	28	30	31	48	11	0	0	24	15
23	40	10	24	40	25	30	Jan. 8	40	11	4	0	21	40
31	32	10	28	0	21	50	16	32	11	8	20	18	40
Jan. 8	24	11	1	40	16	50	24	24	11	13	0	14	10
16	16	11	3	15	10	30	Feb. 1	16	11	18	0	8	45
24	8	11	4	0	0	45	9	8	11	21	45	0	45
Feb. 1	Perihel.	10	27	45	12	45 N	17	Perihel.	11	21	30	11	30 N
9	8	10	16	40	24	0	25	8	11	15	0	23	30
17	16	10	5	40	29	0	March 5	16	11	4	0	32	45
25	24	9	28	10	30	0	13	24	10	21	20	37	15
March 5	32	9	24	0	30	5	21	32	10	10	15	39	30
13	40	9	20	50	29	30	29	40	10	1	20	40	0
21	48	9	18	0	28	40	April 6	48	9	23	0	39	30
29	56	9	14	0	28	20	14	56	9	13	10	39	0
April 6	64	9	10	15	28	5	22	64	9	3	40	38	0
14	72	9	5	30	27	30	30	72	8	24	0	35	30
22	80	9	0	30	26	30	May 8	80	8	16	0	32	35
30	88	8	25	20	24	55	16	88	8	9	20	28	30
May 8	96	8	19	0	23	30	24	96	8	3	0	25	15

Perihelion, March 5, 1789.

Perihelion, March 21, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° '	Geocentric Latitude. ° '
Nov. 29	96	10 · 20 · 30	32 · 30 S
Dec. 7	88	10 · 21 · 50	30 · 45
15	80	10 · 24 · 10	28 · 55
23	72	10 · 26 · 40	27 · 0
31	64	11 · 0 · 0	25 · 15
Jan. 8	56	11 · 3 · 40	23 · 15
16	48	11 · 7 · 35	21 · 30
24	40	11 · 12 · 40	19 · 0
Feb. 1	32	11 · 18 · 0	16 · 20
9	24	11 · 24 · 0	12 · 20
17	16	0 · 0 · 30	7 · 35
25	8	0 · 7 · 0	0 · 30
March 5	Perihel.	0 · 11 · 15	9 · 40 N
13	8	0 · 10 · 40	21 · 30
21	16	0 · 5 · 15	33 · 45
29	24	11 · 24 · 0	44 · 15
April 6	32	11 · 8 · 45	53 · 15
14	40	10 · 17 · 45	61 · 5
22	48	9 · 21 · 40	59 · 30
30	56	8 · 26 · 30	56 · 0
May 8	64	8 · 9 · 0	49 · 0
16	72	7 · 28 · 30	41 · 0
24	80	7 · 23 · 0	34 · 15
June 1	88	7 · 19 · 0	28 · 0
9	96	7 · 17 · 0	23 · 35

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S ° '	Geocentric Latitude. ° '
Jan. 16	64	11 · 6 · 30	23 · 0 S
24	56	11 · 11 · 0	21 · 15
Feb. 1	48	11 · 15 · 35	19 · 20
9	40	11 · 21 · 20	17 · 20
17	32	11 · 27 · 30	14 · 45
25	24	0 · 4 · 30	11 · 5
March 5	16	0 · 12 · 15	6 · 40
13	8	0 · 20 · 0	0 · 25
21	Perihel.	0 · 27 · 0	8 · 30 N
29	8	1 · 2 · 0	18 · 45
April 6	16	1 · 4 · 45	30 · 45
14	24	1 · 6 · 25	44 · 50
22	32	1 · 9 · 0	61 · 30
30	40	1 · 21 · 35	79 · 50
May 8	48	6 · 15 · 30	79 · 0
16	56	6 · 27 · 30	60 · 30
24	64	6 · 29 · 35	46 · 45
June 1	72	7 · 1 · 45	36 · 45
9	80	7 · 3 · 15	29 · 30
17	88	7 · 5 · 50	24 · 0
25	96	7 · 7 · 0	20 · 10

Perihelion, April 6, 1789.

Perihelion, April 22, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S O '	Geocentric Latitude. O '	Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S O '	Geocentric Latitude. O '
Feb. 17	48	11 . 23 . 30	17 . 30 S	March 13	40	0 . 8 . 20	15 . 25 S
25	40	0 . 0 . 20	16 . 10	21	32	0 . 15 . 15	13 . 0
March 5	32	0 . 6 . 45	13 . 45	29	24	0 . 23 . 45	9 . 45
13	24	0 . 14 . 0	10 . 15	April 6	16	1 . 2 . 50	5 . 45
21	16	0 . 22 . 40	6 . 15	14	8	1 . 13 . 10	0 . 10
29	8	1 . 3 . 0	0 . 15	22	Perihel.	1 . 24 . 0	6 . 45 N
April 6	Perihel.	1 . 11 . 20	7 . 30 N	30	8	2 . 5 . 45	14 . 15
14	8	1 . 20 . 0	16 . 15	May 8	16	2 . 18 . 20	22 . 30
22	16	1 . 28 . 45	26 . 25	16	24	3 . 4 . 0	30 . 15
30	24	2 . 10 . 35	37 . 45	24	32	3 . 24 . 30	36 . 15
May 8	32	3 . 1 . 0	49 . 15	June 1	40	4 . 17 . 35	38 . 0
16	40	4 . 2 . 20	55 . 30	9	48	5 . 9 . 0	35 . 30
24	48	5 . 6 . 45	52 . 0	17	56	5 . 25 . 30	31 . 0
June 1	56	5 . 29 . 0	43 . 30	25	64	6 . 6 . 40	26 . 15
9	64	6 . 11 . 0	35 . 0	July 3	72	6 . 15 . 30	22 . 15
17	72	6 . 19 . 0	28 . 30				
25	80	6 . 24 . 35	23 . 30				
July 3	88	6 . 29 . 30	19 . 30				

Perihelion, May 8, 1789.

Perihelion, May 24, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S O '	Geocentric Latitude. O '	Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S O '	Geocentric Latitude. O '
April 6	32	0 . 24 . 0	12 . 45 S	April 22	32	1 . 2 . 45	12 . 40 S
14	24	1 . 3 . 0	9 . 30	30	24	1 . 12 . 10	9 . 20
22	16	1 . 12 . 50	5 . 30	May 8	16	1 . 22 . 45	5 . 25
30	8	1 . 24 . 0	0 . 10	16	8	2 . 4 . 30	0 . 8
May 8	Perihel.	2 . 6 . 30	6 . 30 N	24	Perihel.	2 . 18 . 0	6 . 20 N
16	8	2 . 19 . 30	13 . 0	June 1	8	3 . 2 . 30	11 . 45
24	16	3 . 4 . 0	19 . 25	9	16	3 . 17 . 30	17 . 0
June 1	24	3 . 20 . 40	24 . 45	17	24	4 . 4 . 0	20 . 45
9	32	4 . 9 . 20	28 . 0	25	32	4 . 21 . 20	22 . 45
17	40	4 . 28 . 0	28 . 30	July 3	40	5 . 7 . 20	22 . 45
25	48	5 . 14 . 30	26 . 30	11	48	5 . 21 . 10	21 . 15
July 3	56	5 . 28 . 0	24 . 0	19	56	6 . 2 . 40	19 . 30
11	64	6 . 8 . 10	20 . 50	27	64	6 . 12 . 0	17 . 20
19	72	6 . 16 . 30	18 . 15	Aug. 4	72	6 . 19 . 30	15 . 30
27	80	6 . 23 . 0	16 . 0	12	80	6 . 26 . 0	13 . 50
Aug. 4	88	6 . 29 . 0	14 . 0				

Perihelion, June 9, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.	
		S	O	'	O	'
May 8	32	1	. 11	. 30	12	. 45 S
16	24	1	. 21	. 40	9	. 15
24	16	2	. 3	. 0	5	. 20
June 1	8	2	. 15	. 0	0	. 20
9	Perihel.	2	. 29	. 20	5	. 45 N
17	8	3	. 14	. 20	10	. 55
25	16	4	. 0	. 0	15	. 10
July 3	24	4	. 16	. 0	18	. 15
11	32	5	. 1	. 40	19	. 30
19	40	5	. 16	. 0	19	. 15
27	48	5	. 28	. 10	17	. 45
Aug. 4	56	6	. 8	. 20	16	. 30
12	64	6	. 16	. 40	15	. 0
20	72	6	. 24	. 0	13	. 30

Perihelion, June 25, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.	
		S	O	'	O	'
May 16	40	1	. 11	. 0	15	. 20 S
24	32	1	. 20	. 0	12	. 55
June 1	24	2	. 1	. 10	9	. 30
9	16	2	. 12	. 30	5	. 20
17	8	2	. 25	. 30	0	. 15
25	Perihel.	3	. 10	. 0	5	. 30 N
July 3	8	3	. 25	. 20	10	. 15
11	16	4	. 11	. 10	14	. 0
19	24	4	. 27	. 0	16	. 10
27	32	5	. 11	. 30	17	. 15
Aug. 4	40	5	. 24	. 30	16	. 50
12	48	6	. 5	. 20	15	. 40
20	56	6	. 15	. 0	14	. 30

Perihelion, July 11, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.	
		S	O	'	O	'
May 24	48	1	. 10	. 45	17	. 45 S
June 1	40	1	. 19	. 15	16	. 10
9	32	1	. 29	. 20	13	. 30
17	24	2	. 10	. 0	9	. 45
25	16	2	. 22	. 20	5	. 30
July 3	8	3	. 6	. 0	0	. 10
11	Perihel.	3	. 21	. 0	5	. 30 N
19	8	4	. 6	. 10	9	. 45
27	16	4	. 22	. 30	13	. 0
Aug. 4	24	5	. 7	. 20	14	. 50
12	32	5	. 21	. 0	15	. 30
20	40	6	. 2	. 40	15	. 0
28	48	6	. 12	. 20	14	. 0

Perihelion, July 27, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude.			Geocentric Latitude.	
		S	O	'	O	'
June 1	56	1	. 10	. 0	20	. 15 S
9	48	1	. 18	. 20	19	. 0
17	40	1	. 27	. 40	17	. 5
25	32	2	. 8	. 0	14	. 15
July 3	24	2	. 19	. 30	10	. 20
11	16	3	. 2	. 10	5	. 45
19	8	3	. 16	. 0	0	. 10
27	Perihel.	4	. 1	. 30	5	. 30 N
Aug. 4	8	4	. 17	. 20	9	. 45
12	16	5	. 2	. 45	12	. 30
20	24	5	. 17	. 0	14	. 0
28	32	5	. 29	. 40	14	. 20
Sept. 5	40	6	. 10	. 40	13	. 45
13	48	6	. 20	. 0	13	. 0

Perihelion, Aug. 12, 1789.

Perihelion, Aug. 12, 1789.

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S. O ' "	Geocentric Latitude. O ' "
June 9	64	1 . 9 . 15	22 . 45 S
17	56	1 . 17 . 0	22 . 0
25	48	1 . 26 . 0	20 . 35
July 3	40	2 . 6 . 15	18 . 45
11	32	2 . 17 . 0	15 . 30
19	24	2 . 29 . 10	11 . 15
27	16	3 . 12 . 30	6 . 15

Days of the Month.	Distance from the Perihel. in days.	Geocentric Longitude. S O ' "	Geocentric Latitude. O ' "
Aug. 4	8	3 . 26 . 30	0 . 10 S
12 Perihel.		4 . 12 . 20	5 . 40 N
20	8	4 . 28 . 30	9 . 45
28	16	5 . 13 . 20	12 . 15
Sept. 5	24	5 . 27 . 10	13 . 15
13	32	6 . 9 . 0	13 . 45
21	40	6 . 19 . 0	13 . 0

P O S T S C R I P T.

I HAD omitted mentioning in its proper place, another use to which the annexed drawing of the Comet's Orbit may be applied; viz. to the seeing at once whether any observed Comet is the one we are seeking. Suppose, for example, that a comet is observed on January 20th, 1789, with a longitude of $7^s\ 20^\circ$, and 10° south latitude, draw a line through the sun, cutting the ecliptic in the observed longitude, and a parallel line passing through the place of the earth in its orbit, does not cut the orbit of the comet at all; and therefore, the comet observed cannot be the one of 1661.

Suppose the observed longitude had been $9^s\ 10^\circ$, and its latitude 10° south; in this case, a line drawn as above will cut the comet's orbit; but in a part where it must have an high northern latitude; and therefore, this likewise cannot be the expected comet.

Suppose the longitude of the comet observed as above to be $9^s\ 12^\circ\ 30'$, and its latitude north to be $21^\circ\ 30'$; by the operation above stated it will appear, that the comet we seek will have that longitude eight days after its perihelion with a northern latitude. The method given in the former part of the work will at once find the latitude for these points, which is just what was observed. This comet may therefore be the one sought; but it will require two observations more to bring it to a certainty, as many parabolas may pass through two given points, but only one can pass through three such points.

Description of a Method of taking the differences of Right Ascension and Declination ; with the Reticule Rhomboide of Dr. Bradley, without placing the Instrument in the Plane of the Equator.

THE very ingenious system of Wires, invented by Dr. BRADLEY, for taking differences of Right Ascension and Declination, and called since *the Reticule Rhomboide*, has this inconvenience in common with all others, that it requires being placed in an equatorial position.

As this is scarcely possible without an equatorial motion in the stand of the telescope, and even then is not accomplished either with ease or expedition, a method of applying the Rhomboid, by which a considerable degree of accuracy may be obtained, without the least regard to the position of the instrument, provided it be but steady, must be often extremely convenient, and may sometimes be very useful, particularly with respect to comets, which are seen at times when the observer may not have accurate instruments at hand, or time to remove and replace those which he has ; whereas this method requires no preparation

but pointing the telescope to the object intended to be observed.

It is scarce necessary to say, that the construction of the Rhomboid is by forming a triangle, whose base (vid. fig. 1.) B C is equal to the perpendicular A D. Then by the properties of similar triangles, the differences of every line drawn parallel to the base will be equal to the parts of the perpendicular intercepted between those lines. Thus let. 1. 1. and 2. 2. (fig. 1.) be the paths of two stars through the Rhomboid; the difference of $\alpha \beta$ and $\gamma \delta$, the transits of the stars through the field of the Rhomboid, will be equal to $\varepsilon \zeta$, their difference in Declination. Their difference of Right Ascension is found by halving the observed lines of the transits, which of course gives their passage over the centre of the instrument, no other wires being used but A. B. and A. C.

In practice, the Rhomboid is completed by joining two of these triangles by the base, in order that the whole extent of the field of the telescope may be applied to difference of Declination (vid. fig. 3.); but the theory of the instrument exists in either of the triangles.

In order to make observations with the instrument out of an equatorial position, it is necessary to have a third wire bisecting the Rhomboid, as in fig. 2. and the appulses of the bodies to be compared, must be observed to each of the three wires. A drawing must be prepared of the Rhomboid,

Rhomboid, of such a size, that a second of time may be equal to about a tenth of an inch, or about twice the size of fig. 2. Then with a scale of equal parts, cut on a chamfered edge, apply the observed times of the transits of each star to the figure, so that they may exactly correspond to the observations, and draw pencil lines, which, if the observations are well made, will be parallel. The distance between these lines will be equal to the difference of Declination of the two stars, measured on the same scale of equal parts; which must be reduced to degrees and minutes of a great circle, at the rate of a degree to four minutes, as usual: and a line let fall from the point of transit of one star, through the middle wire perpendicularly on the path of the other, will give the correction of the differences of Rt.Asc. observed by the middle wire; that correction being measured from the point where the above-mentioned perpendicular cuts the path of the star, to that star's transit over the middle wire; which correction will, when the Rhomboid declines westward, as in fig. 2. be additive when the northern star precedes in Right Ascension, and subtractive when the southern one precedes; and the contrary when the Rhomboid declines eastward.

Thus in fig. 2. let 1. 1. and 2. 2. be the paths of two stars observed through the Rhomboid, and let the distance $\alpha \beta$ be twenty-one seconds in time; $\beta \gamma$ ten seconds; $\delta \epsilon$ thirty-five seconds; and $\epsilon \zeta$ be sixteen seconds and a half; then, if a scale of one-twentieth of an inch to a second be used,
they

they will appear as in the Drawing, and the difference of Declination will be the perpendicular $o\epsilon$, or βo , equal to twelve seconds in time, or $3'$ of a degree; and the correction to be applied as above directed to the differences of Right Ascension found by the transits of the stars over the central wire A. D. will be the space $o\beta$, or ϵo , equal to $8\frac{1}{2}$ seconds in time.

If one of the stars at 3. 3. passes over the lower half of the Rhomboid, the operation is exactly the same, as is evident by inspection of the figure where θ is $29\frac{1}{2}$ seconds, θi 26 seconds. The difference of Declination between 2. 2. and 3. 3. is $\epsilon\phi = 17$ seconds, or $4' 15''$ of a degree, and $\theta\phi$ the correction for the Right Ascension $12\frac{1}{3}$ seconds.

I have hitherto, for the sake of simplicity, considered the stars to be observed as being in the equator; when they are not, previous to every other operation, the observed times must be reduced to equatorial, by multiplying them by the cosine of the Declination; but this is necessary in the usual method of observing with the Rhomboid. It is also to be observed, that the lines of the two stars' paths through the instrument, when laid down on the drawing, will seldom be exactly parallel, as a very little error in the observations will sensibly affect their parallelism; but if the inclination be small, it will cause but a very slight error in the measure of the Declination, which I generally take in the centre of the instrument.

For

For observations of comets, whose light is often so feeble as not to bear any illumination to the wires, it is necessary to have them large; or, perhaps, it is still better to have the inclined parts of the Reticule made of narrow plates, feather edged, as the emerfion and immerfion of a faint comet from their interior edges, is a more accurate observation than any that can be made with wires. In fuch a cafe, if the telescope be fet fteady, it is not neceffary to obferve the bifection of the comet by the central wire, but only that of the ftar with which it is compared; and having laid down the path of the ftar as before directed on the drawing, with a parallel ruler draw a line parallel to the path of the ftar, and containing in the figure of the Reticule, the obferved number of feconds employed by the comet to traverse the Reticule, and then proceed as before directed: but, if poffible, it is always beft to obferve both ftar and comet at the central wire, as then the obfervations, when laid down, are a check on each other.

I have reafon to think, by a comparifon of feveral obfervations made in the above-defcribed method on the comet of 1786, when very faint, and compared by Dr. Maskelyne with his own at Greenwich; that in the moft unfavourable circumftances, this way will not be fubject to an error of more than a fecond and an half in time in Right Afcenfion: and $20''$ in Declination, even at confiderable diftances from the equator.

F I N I S.

The Orbit of the COMET of 1661, (whose Return is expected about January 1789) projected on the Plane of the Ecliptic, and divided to every Fourth Day.

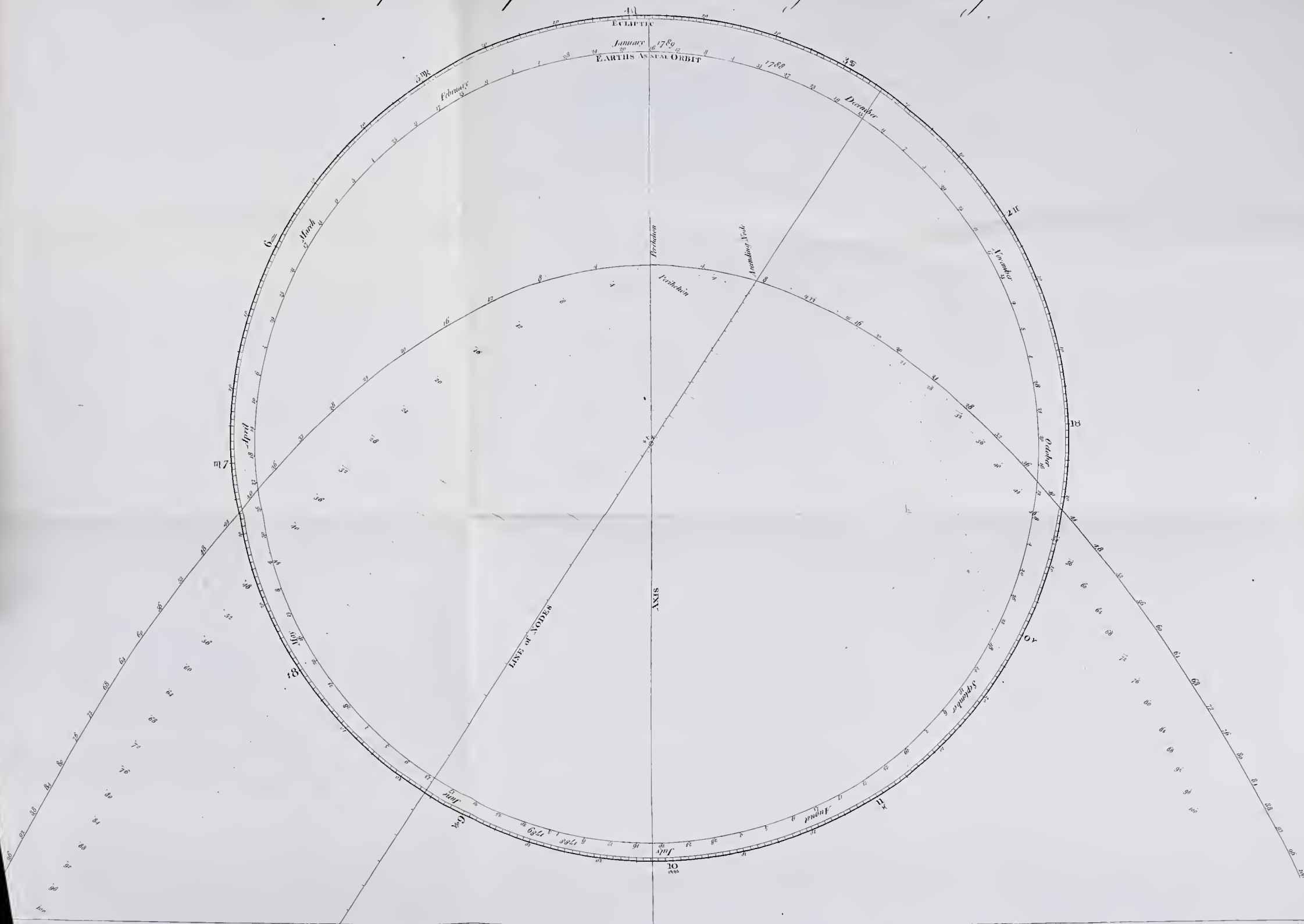


Fig: 1

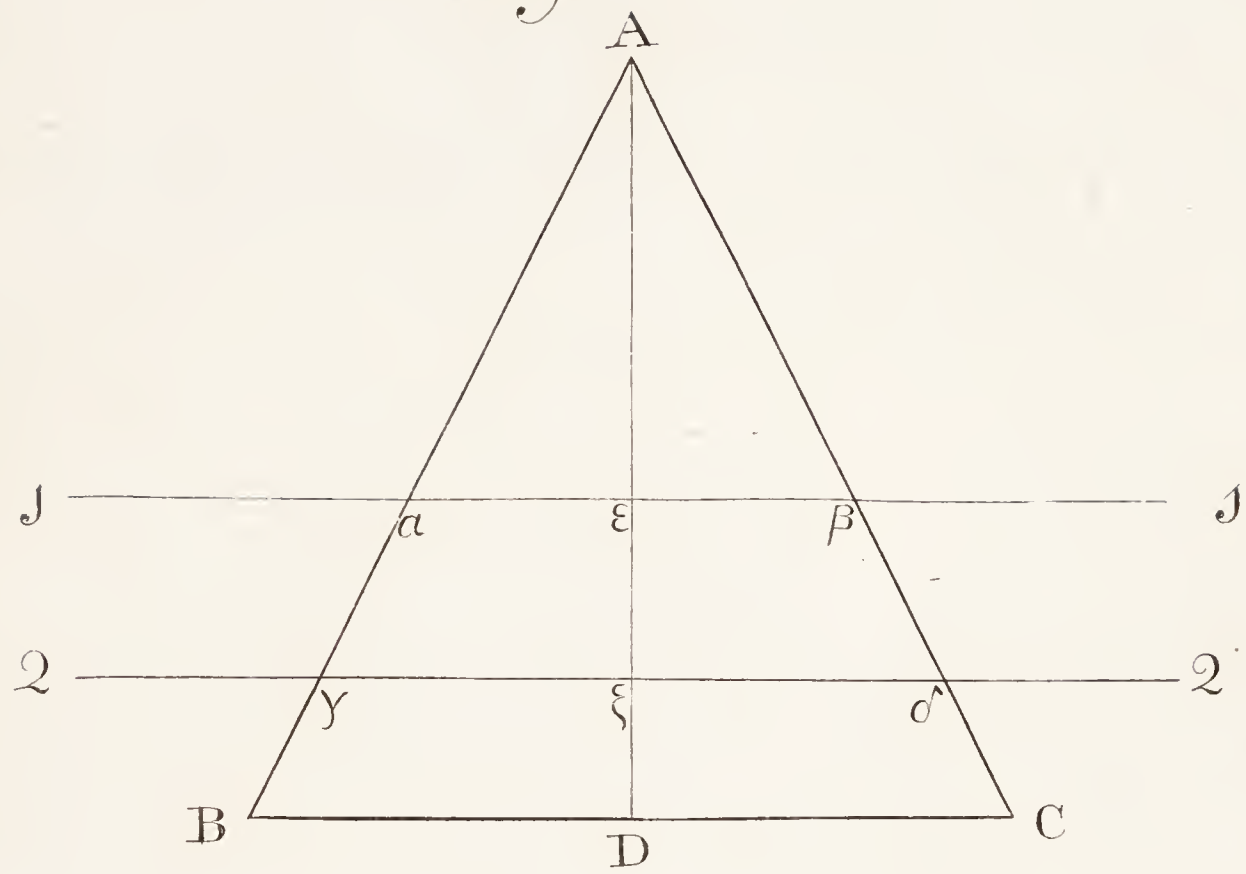


Fig: 2

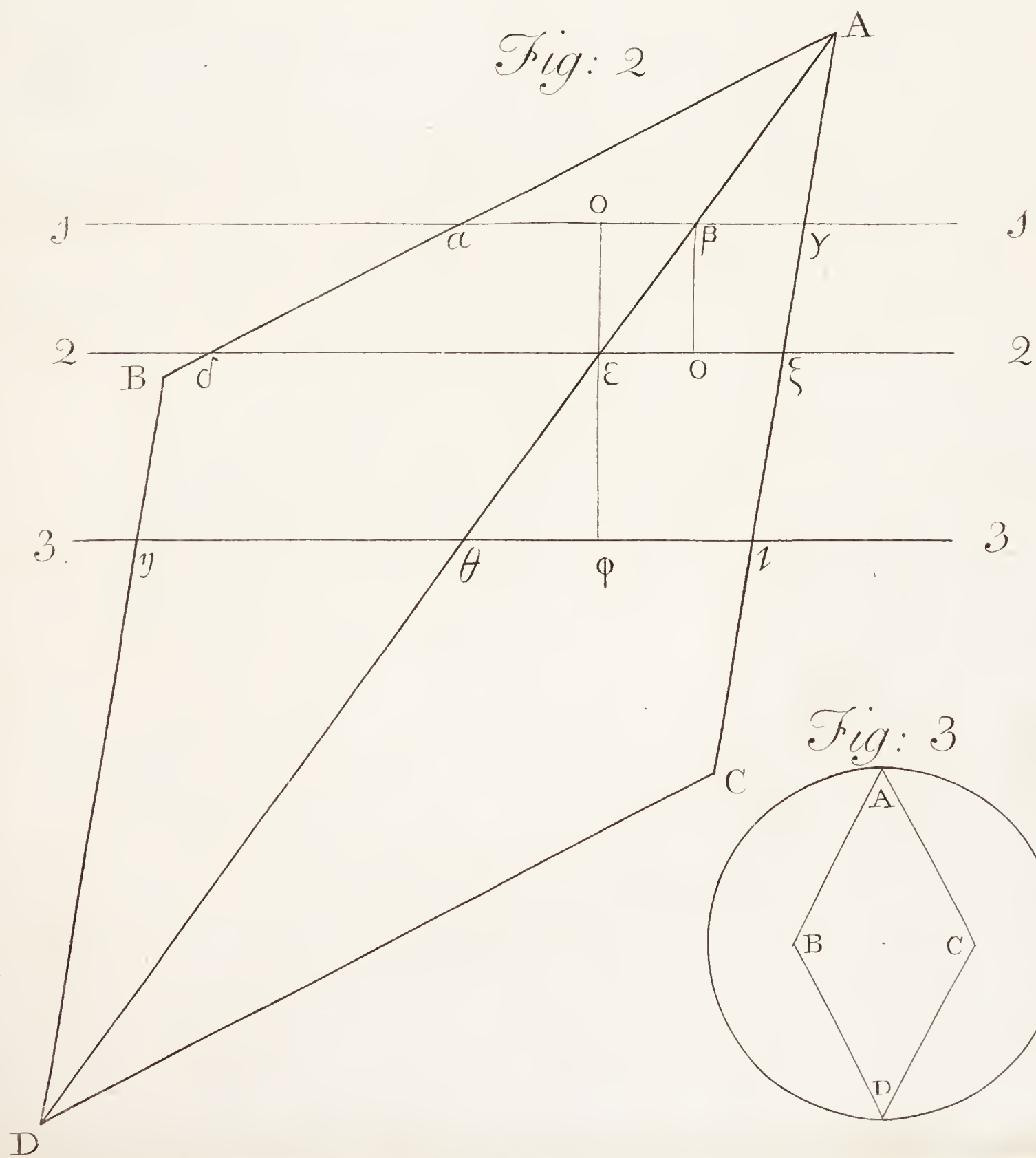


Fig: 3

